8.0 Summary of the thesis:

It is generally assumed that all native speakers are endowed with the intuitive knowledge about the strength asymmetries of the speech sounds evident in their language system. There is a need to represent this strength relation responsible for the organization of the sounds in a non-arbitrary way. This dissertation is an attempt at representing this underlying patterning of segments holding between units of representation in an explicit manner with rational as well as empirical evidence.

This study drives home the point that the notion of phonological strength is instrumental in the phonological patterning of segmental asymmetry in addition to the hierarchical representation of phonological features. As seen in the preceding chapters, phonological strength relation has been interpreted in this study from various perspectives such asmetrical phonology, feature geometry, dependency phonology and government phonology, positional faithfulness and positional augmentation approach, licensing by cue model, pure prominence model and Element theory etc. The findings of this thesis can be subsumed under two headings: phonological and phonetic. Although phonetic conditions can not be dissociated from phonological theorizing yet for convenience the findings of this study are divided into two separate headings although the findings in general claim that positional asymmetry is not only phonologically patterned in a dynamic and distributional way but also phonetically authenticated. In other words, the onset coda asymmetry this study shows has some phonetic underpinnings. In other words, positional neutralization of the features suggest that features are licensed preferentially in those positions in which phonetic conditions make them maximally robust. And features are subject to alternation where they are phonetically weak, that is characterized by articulatory less effort.

8.1 Phonological findings:

In this study various phonological processes are taken into account in order to deal with the issue of phonological strength. These processes include assimilation, spirantization, consonant cluster, aspiration and gemination. So the findings pertaining to phonological strength are discussed in relation to each phonological process.
Prosodically stronger positions such as onsets and initial positions attest the process of fortition such as aspiration which is subject to loss in weaker positions.

The process of lenition such as spirantization targets mostly the prosodically weaker positions such as word final and coda position. The Assamese data on coda deaspiration and spirantization presented in chapter Five bears ample testimony to this finding.

8.1.1 Assimilation and phonological strength findings:

The phonological process of assimilation can successfully provide an account of strength asymmetries in phonological patterning of speech segments. Mostly the segments in the onset position are retained whereas the segments in the coda position are subject to alternation. As seen in the Assamese data on regressive voicing assimilation in Chapter Four, it is possible to formulate the generalization that onset position is stronger than the coda position and thereby it is quite justifiable to uphold the claim of Positional privilege. Assamese exhibits the instances of regressive voicing assimilation (see 4.2), in which it is seen that the segment occurring in the coda position tends to agree in terms of feature \[\text{voice}\] with the following voiced obstruent in the onset position thereby strengthening the claim that positional asymmetry is instrumental in the functioning of the segmental distribution.

Apart from onset coda asymmetry the data under consideration shows that assimilation is blocked by nasals and liquids. This assimilatory prohibition in terms of feature \[\text{voice}\] can be justified by taking in to account the sonority value embedded in a segment. In the same fashion the Pali geminates (see 7/12) resulting as a process of assimilation in the course of development from Sanskrit also In the data under consideration it is perceived that onsets are stronger than codas because the onsets resist assimilation whereas the codas are prone to assimilation. Since obstruent clusters agree in terms of sonority value they display assimilation which is blocked among the segments of different class such as nasals, laterals and rhotics which are characterized by diverse sonority values. Voicing assimilation is functional among the segments of same sonority value and this is blocked between the segments of asymmetric sonority value. However the redundant \[+\text{voice}\] feature of a sonorant consonant never triggers voice dissimilation. Hence, I propose a constraint using Optimality theoretic module that drives home the point that AGREE is stronger between similar constituents having similar sonority value. In the data of Assamese under consideration it is found that stops act as the trigger of assimilation whereas the nasals
undergo assimilation but not vice versa. So from this patterning a conclusion is drawn that segments with less sonority value resist assimilation to segments having high sonority value.

The fact that the phenomenon of assimilation can reflect upon the notion of phonological strength is obvious from the observation of the data on Pali geminates in Chapter Eight. The Pali geminates under investigation are derived as a process of assimilation from Sanskrit in the course of development. From the data on Pali it is revealed that whenever there are two adjacent obstruent clusters, one in the coda position and the other in the onset position, the segment in the coda position assimilates to the following consonant in the onset position and thereby establishes the claim of positional privilege and onset coda asymmetry in distribution. But, what is interesting to observe is that whenever the segment in the onset position is either liquid or nasal being preceded by obstruent in the coda position of the previous syllable the onset segment assimilates to the preceding coda segment. This phenomenon can be explained with reference to sonority parameter. We have already seen that whenever there are two adjacent segments of same sonority value, mostly obstruents, coda segment assimilates to the following obstruent in the onset position. But when the adjacent segments are of asymmetric sonority value, that is, liquids or nasals on the onset position and obstruents in the coda position, the former assimilates to the latter and thereby violates the dictum of positional privilege. A more complex segment is a better candidate to be assimilated whereas the less complex segment is susceptible to alternation.

8.1.2 Spirantization and phonological strength findings:

Spirantization is treated in this dissertation as a process of lenition which is found to be attested in the word final position. In addition to the deaspiration which is attested in the coda position of the Assamese data under consideration as presented in Chapter Six, it is seen that spirantization is found in the coda or the word final position and thereby supports the claim of positional asymmetry or positional privilege. Some of the findings, as already outlined in Chapter Six are listed below:

a) In Assamese aspirated stops /pʰ/ and /bʰ/ are spirantized as [f] and [v] in word final position, leaving the unaspirated stops intact.
b) Spirantization is never attested in word initial and medial position as evident from the data on Assamese. However, cross linguistically word medial position is found to be the suitable place for spirantization to occur.

c) Deaspiration in Assamese does not apply at the end of a phrase when no following consonant occurs. In Assamese, coda is deaspirated when it is followed by an aspirated onset. However, the fricatives /ʃ/ and /v/ never lose their feature [+s.g.] despite the fact that both of these consonants occur in the word final position or in coda position, being followed by aspirated onset. They turn into /ph/ and /fbh/ respectively when they are followed by obstruents. Nevertheless, the feature [+s.g.] is maintained in the onset position which does not undergo alternation. The distribution of Assamese aspirated phonemes at word boundary it is observed that only the labial stops spirantize at the word final position unlike coronal and velar stops which are not susceptible to the process of spirantization. This happens to be a language specific. It is because cross linguistically labials are not only the better candidates for aspiration. In fact all the places, labials, dental/alveolars and velars fare equally well for the distribution of aspirated consonant phonemes. So using the constraint rankings within the purview of OT this observation in Assamese data on spirantization can be established. The ranking of the constraints which I have shown in (5/21) can be cited here. For details consider the tableau 5/g of Chapter Five.

*+[cont] [-cont]>> Faith [s.g.] & Faith [cont] >> *OCP-s.g. >> *[s.g.]> CodaCon

8.1.3 Aspiration and phonological strength findings:

The process of aspiration, which is generally treated as a process of fortition is also functional in the patterning of segmental speech sounds in orderly fashion correlating with the notion of phonological strength and prosodic positional asymmetry.

The fact that phonological strength of a segment can be correlated with the prosodic positions is supported in this study with examples drawn from the distribution of aspirated phonemes in Hindi. The Hindi data on aspiration as presented in Chapter Seven within the framework of Element theory clearly show that prosodic positions determine the licensing and neutralization of features. Aspiration as a fortition process always chooses the archetypal foot initial or word initial position, but word final or the coda position is not a better candidate for the licensing of aspiration. It implies that melodic strength and prosodic strength are
complementary to each other. Prosodic strength or the positional strength stimulates the emergence of the melodic strength of a segment. From these findings a generalization can be formulated that melodic strength and prosodic strength are intertwined. It is melodic strength which reflects prosodic strength and melodic strength is achieved through headship and prosodically strong positions are those which help language processing by indicating the location of various prosodic domains. The examples of Hindi aspirated stops are indicative of the fact that the full set of laryngeal contrasts is supported in the inherently strong word initial position. This is true for the stop system as a whole, including labial, dental, velar series. The findings further strengthen the claim that strong or headed expressions can only be realized in prosodically strong positions as put forward by Backley and Nasukawa (2006) as well as Vaux and Samuels (2005).

8.1.4 Gemination and phonological strength findings:

The phonological process of gemination, a process of fortition, also proves in this study to be a suitable process in the delineation of phonological strength pertaining to segmental speech sounds. The study on the process of gemination in this thesis (presented in Chapter Seven) clearly implies that the intrinsic properties embedded in a segment can determine the segmental distribution in a phonological domain. In this study on the process of gemination with examples drawn from Sanskrit it becomes evident that only the liquids and the glides have the potential to trigger gemination to the previous obstruent unlike nasals and obstruents. Glides and liquids have the special property of being appropriate coda as well as a member in the onset consonant cluster resulting in the process of gemination. Obstruents and liquids together can satisfy the coda condition as well as the well formed consonant cluster. The process of gemination can help in satisfying these two conditions.

8.1.5 Consonant cluster and phonological strength findings:

Behind the patterning of consonant cluster in a specific manner the notion of phonological strength can be realized. A justification can be made as to why stops and nasals can function as the word initial cluster in most of the languages whereas liquids fail to be the first member of a word initial cluster in the backdrop of segmental complexity involved in governing relations. In Chapter Six an analysis of this issue is made with data from Assamese. These
sorts of findings are instrumental in the formulation of the notion that the intrinsic make up of the segment is responsible in the patterning of the phonotactics of a language.

a) The inability of the liquid to be the initial member of a consonant cluster is analysed in this dissertation in the light of constituent government relations (Harris 1990). The syllabification of adjacent segments is determined by the governing relations and it is the constituent government which determines what constitutes a well formed branching constituent. As the approximant is governed by the stop and the liquid by the nasal, hence a downward complexity slope is enforced between a governor and a governee. Thus it permits the consonant cluster such as pr, mr etc. in the phonotactics of the language. The reasons as why p governs r can be answered from the internal make up of the two segments. Whereas p bears two internal elements U° and P° r possesses only one internal component, which is R°. It further implies plosives govern liquids on the ground that plosives are more complex than liquids in terms of internal components involved in representation. According to Harris (1990) the more sonorant a segment, the less complex its representation. But Rice (1992) has argued that greater sonority implies greater complexity. It is evident that laterals have more SV structure than nasals and in that scale stops can be placed at the bottom in terms of the number of SV structure. Thus the sonority profile within an onset is thus met only if the second consonant has more SV structure than the first. In this framework stop has two nodes ROOT and SL whereas liquid has three nodes namely ROOT, SL and SV. Consider the following representation which is already shown in Chapter Six:

```
Stop       Lateral

ROOT       ROOT
  |
  SL       SL
  |
  SV
```
Even the organization of consonant cluster consideration Margin hierarchy of Prince and Smolensky (1993), that gives preference to segments of low sonority. This constraint is applicable to singleton onsets or to the first member of an onset cluster and it is known as M1 hierarchy. In the same way, the M2 hierarchy applies both to the second member of an onset and a singleton coda. It differs from M1 hierarchy in the sense that it gives preference to consonants of high sonority.

M1 hierarchy (preference given to consonants of low sonority)

*\( M1/r \) >> *\( M1/1 \) >> *\( M1/\) Nas >> *\( M1/obs \)

M2 hierarchy (preference given to consonants of high sonority)

*\( M2/obs \) >> *\( M2/\) Nasal >> *\( M2/l \) >> *\( M2/r \)

These constraints stated above have a bearing upon the functionally grounded onset sonority implications. Crosslinguistically it is observed that word initial onsets prefer segments of low sonority value. The instances of Assamese data adhere to the crosslinguistic preference for low sonority onsets which has been documented in the literature. This preference is clearly discerned when a choice has to be made between two different available onsets.

In addition, the prohibition of two coronals together in a syllabic organization is dealt here in this study in the framework of Binding parameter and coronality constraint within Optimality theoretic module. The prohibited consonant cluster such as */tl/ can be accounted for in the light of binding principles.

```
  t    l
 ROOT  ROOT
   |       
|     
Place  Place  SV
          |
         Lateral
```
This cluster under consideration adheres to the criteria of government as the second consonant has more SV structure than the first one. But /l/ shares the place of articulation with /t/ and therefore it is bound and thereby violates the binding principle. The reason for the non occurrence of these sorts of clusters can be assigned to OCP coronal constraint within Optimality theoretical module:

OCP-COR constraint implies that two segments having coronal and continuancy values cannot occur in adjacent position.

\[ \text{OCP-COR constraint} \]
\[ *\{+\text{COR}\} \]
\[ [-\text{CONT}] [-\text{CONT}] \]

d) In this study an attempt is made to justify the s-obstruent cluster which has been a topic of controversy in literature. Cross linguistically it has been observed that s-obstruent cluster is the falling sonority cluster which does not adhere to the principle of sonority sequencing generalization. In Assamese phonotactics, homorganic clusters such as /tl/, /dl/ are disallowed in word initial cluster on the ground of violation of OCP coronal constraint, but clusters such as /sl/, /sn/ and /st/ exist in the language despite being homorganic coronal clusters. Further /s/ is the only sound that may be followed by a nasal in word initial clusters. Moreover, sonority sequencing constraints such as syllable contact treats s-obstruent clusters differently from obstruent-sonorant clusters. s-obstruent clusters have falling sonority; hence epenthesis at the edge is possible and preferred resulting in the constructions such as skul > is.kul. In this way in most of the loan word in Assamese beginning with obstruct s-, epenthesis occurs at the edge. The crucial assumption here is that the default site of epenthesis in loan words is at the edge. SYLLABLE CONTACT is not violated and hence, CONTIGUITY ensures that edge epenthesis is optimal. This outcome can be expected as long as SYLLABLE CONTACT is ranked above CONTIGUITY, although its ranking in relation to DEP is not crucial. This pattern is termed as the Emergence of the Unmarked effect.

These observations as evident in the previous discussion bear consonance with Beckman’s Positional faithfulness view and Jeniffer Smith’s Positional augmentation effects which drive
home the point that the intrinsic property of the segment is instrumental in the patterning of segmental distribution in a phonological string.

8.2 Phonetic findings:

The notion of strength bears phonetic underpinnings too, especially in relation to acoustic parameters. Strength is interpreted not only in terms of phonological theories but also subject to phonetic implications. As outlined the case of h-deletion in Hindi it is found that h in the word onset and h in the word coda position are characterized by different acoustic properties. The findings are listed below:

i) The observation proves the assumption that there lies a correlation between specific articulatory states and gestures and specific acoustic cues. It further implies that phonetic and articulatory gestures can not be studied without taking into account the acoustic cues. Phonological features are licensed by both articulatory and acoustic parameters.

ii) This study bears ample testimony to the fact that the defining acoustic attributes of a feature are a direct consequence of its articulatory definition. The fact that onset coda asymmetry can have phonetic implications is shown in Chapter Seven with reference to h deletion in Hindi. With the help of PRAAT analyses it becomes quite evident that ‘h’ in onset position and ‘h’ in coda position in Hindi are characterized by asymmetric acoustic features. Word initial and word medial ‘h’ followed by ‘a’ display same acoustic features. The reason for this symmetry may lie in the fact that in both the positions (e.g in ‘hathi’ and ‘suhana’) the segment ‘h’ assumes the onset position. ‘h’ in these positions is characterized by acoustic properties which can easily distinguish themselves from surrounding vowels. It is also observed from the PRAAT analysis that ‘h’ loses its formants in the coda position which are present in word initial and onset position. In this position the acoustic properties pertaining to ‘h’ are lost. This position is characterized by less laryngeal noise.

8.3 Reservations:

From the above findings as listed above a conclusion can be drawn that phonological strength is not an abstract notion which has only representational significance in terms of head dependent asymmetry but also has concrete phonetic realizations. With analyses within GP, DP and OT models this thesis has provided an explicit account of phonological strength.
Although the findings of this study are based on the data of languages like Assamese, Hindi, Sanskrit and Pali yet the results emerging from this study are not confined to the phonotactic pattern of a particular language but can be applied in a variety of languages cross linguistically and thereby claiming significant generalizations.

Nevertheless due to the paucity of time this study has not been able to address the issue of strength relations pertaining to assimilation, gemination, spirantization and aspiration from phonetic parameters. The questions which need future explorations are as follows:

a) What sorts of differences can be established in acoustic parameters between the aspirated and unaspirated stops?

b) Is there any difference between the aspirated stops occurring in the word initial position and aspirated stops in the word medial and final position in terms of phonetic properties and thereby correlating with the notion of fortition and lenition? Is it possible to address the issue of onset coda debate in relation to the process of assimilation and the acoustic cues pertaining to segments in different prosodic contexts?

c) To what extent is it possible to address the issue of gemination in terms of phonetic conditions? Whether geminates display more acoustic energy than non geminates is a topic of exploration that needs to be investigated. Why the phenomenon of spirantization is mostly attested in the word and foot final position? Is there any connection between phonological lenition site and acoustic phonetic parameters?

In addition to these questions which need further phonetic investigation the theoretical models such as DP, OT, GP etc. which have been used as frameworks in this study of phonological strength relations, have to be modified in such a way so that they can address the notion in a non arbitrary fashion. These theories, mainly of representation, do not correlate the internal acoustic phonetic cues pertaining to a segment and its distribution in prosodic positions in an explicit canvas. Hence it should be a locus of future research to find out a suitable way to address the notion of phonological strength in an integrated model supported both by phonological theorizing and acoustic phonetic parameters.
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